

REMARKS

Claims 1-12, 14-17, 19, and 20 were previously examined. Claims 6 and 9 have been amended to change their dependency, and claim 20 has been amended to correct a typographical error. Claim 5 has been cancelled. Claims 21-26 have been added. As a result, claims 1-4, 6-12, 14-17, and 19-26 are currently pending. In view of the foregoing amendments and the following remarks, Applicant respectfully submits that the application is in complete condition for allowance and requests reconsideration in this regard.

Rejection of claim 20 under 35 U.S.C. § 112, first paragraph

The Examiner rejected claim 18 under 35 U.S.C. § 112, first paragraph, as failing to comply with the written description requirement. However, Applicants cancelled claim 18 in the Amendment filed on October 29, 2007. Based on the language in the Examiner's rejection, Applicants assume that the Examiner intended to refer to claim 20. For example, the Examiner asserts that the "originally filed specification does not show support for the limitation 'without having to pivot the nozzle.'" Office Action mailed January 17, 2008, p. 2. The only claim in which this language appears is claim 20. Accordingly, Applicants will address the rejection with respect to claim 20.

Claim 20 depends from claim 1, which recites "orienting the jetting valve to provide a jetting direction nonperpendicular to the surface of the substrate." The present application discloses several ways this step can be accomplished. For example, Fig. 2 shows an embodiment in which a jetting dispenser 40 is pivoted about a y-axis 78 to provide the claimed jetting direction. Fig. 4 shows an embodiment where the jetting dispenser 40 does not need to be pivoted to provide the claimed jetting direction. Instead, the embodiment in Fig. 4 incorporates an angled nozzle 90 having an angled exit passage that terminates at an opening 92 (Fig. 5) on a side wall 94 of the nozzle. "With the angled nozzle 90, viscous material is ejected . . . in a jetting direction that is nonperpendicular to upper substrate surface 80." Paragraph [0035] (emphasis added).

Thus, the present application clearly demonstrates that Applicants were in possession of "orienting the jetting valve to provide a jetting direction nonperpendicular to the substrate without having to pivot the nozzle," as recited in claim 20. Positioning the jetting dispenser shown in Fig. 4 of the application relative to a substrate is one example of how this step may be

accomplished. For at least these reasons, Applicants respectfully submit that the rejection under § 112, first paragraph, was in error and requests that it be withdrawn.

Rejection of claim 1 under 35 U.S.C. § 103(a) as unpatentable over Mathias in view of Messerly

The Examiner rejected claim 1 under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 5,565,241 to Mathias et al. ("Mathias") in view of U.S. Patent No. 6,253,957 to Messerly et al. ("Messerly"). According to the Examiner, Mathias teaches dispensing viscous material onto a substrate in a nonperpendicular direction because the viscous material is sprayed onto the substrate. The Examiner asserts "the spray is conical, the substrate is flat, therefore, some spray must be perpendicular." Office Action mailed January 17, 2008, p. 3. However, the Examiner acknowledges that Mathias "does not teach [a] droplet made by valve seat and valve elements." *Id.* at 4. The Examiner then turns to Messerly and states that "[i]t would have been obvious to one of ordinary skill of the art at the time of the invention to have used the valve of [Messerly] to apply the droplets of applicant because [Messerly] teaches that it is a suitable apparatus for droplet application." *Id.* Applicants respectfully submit that the Examiner has overlooked several fundamental differences between Mathias and Messerly that make such a combination improper.

In particular, Mathias discloses a spray device for coating a substrate with a liquid resin that contains reinforcing material (e.g., fibers, glass microspheres, etc.). As shown in Figs. 1 and 2 of Mathias, the device includes a nozzle 1 having a conduit 12 in the form of a hollow cylindrical tube. Liquid resin from one or more supply lines 15 is fed into a back end 12b of the conduit 12. The liquid resin is supplied under pressure so that it travels through the conduit 12 and exits a liquid orifice 7 at a front end 12a of the conduit 12. Air lines/pipes (not labeled) may also extend into and through the conduit 12 to the front end 12a. The air lines supply pressurized air to atomizing holes 6 surrounding the liquid orifice 7. The nozzle 1 also includes reinforcing material supply lines 16 that extend into the conduit 12 and terminate at shaping holes 8 at the front end 12a.

In operation, a continuous stream of the liquid resin is emitted from the liquid orifice 7. The Examiner points to Fig. 2 and col. 3, lines 38-42, for the disclosure of the dispensed material forming a droplet. However, the text referenced by the Examiner merely indicates that droplets

are formed after the liquid resin is atomized by air directed from the atomizing holes 6. Fig. 2 illustrates that pressurized air streams from the atomizing holes 6 converge with and atomize the dispensed material at a point spaced from the liquid orifice 7. The atomization is necessary so that the liquid resin effectively “wets” reinforcing material dispensed from the shaping holes 8. The result is a fan-shaped flow of liquid resin “having an essentially elliptical circumference so that it can be sprayed onto a designated area of the substrate.” Col. 3, lines 64-66 of Mathias.

In contrast, Messerly discloses a jetting dispenser 10' for dispensing minute droplets of viscous material on a substrate, such as a printed circuit board. The minute droplets are formed by a valve element 42' moving toward and impacting a valve seat 38' to force an amount of the viscous material through a nozzle 40'. The jetting dispenser in Messerly is typical of the prior art dispensers discussed by Applicants in paragraph [0003] of the application. In particular, as discussed by Applicants and shown in Fig. 1 of Messerly, the jetting dispenser is oriented substantially perpendicular to the surface of the substrate. Although the formation of minute droplets increases the ability of the jetting dispenser to control the placement of the viscous material on the substrate, the challenges associated with underfill operations discussed by Applicants in paragraphs [0003] and [0004] of the application remain.

If a person of ordinary skill in the art were to combine the teachings of Mathias and Messerly in the manner suggested by the Examiner, neither of the devices would work for their intended purpose. Incorporating a valve element and valve seat into the nozzle 1 of Mathias would result in droplets of the liquid resin being dispensed immediately from the liquid orifice 7. The air directed by atomizing the holes 6 would therefore converge on discrete droplets rather than a continuous stream of the liquid resin. Meanwhile, the reinforcing material would be continuously emitted from the shaping holes 8. At least some of the reinforcing material may not be “wetted” by the liquid resin due to the spacing or timing between the droplets. Mathias states that this is undesirable because “[n]on-uniform mixing decreases . . . the structural integrity of the coating, thereby providing points of strength reduction.” Col. 4, lines 62-64 of Mathias.

On the other hand, if the spraying technique of Mathias, which the Examiner relies upon for the disclosure of the “nonperpendicular” recitations in claim 1, were incorporated into the jetting dispenser of Messerly, the viscous material in Messerly would be atomized and applied to a larger area of the substrate. This would reduce the ability of the jetting dispenser to control the

placement of the viscous material on the substrate. Additionally, the wetted area on the substrate produced by the atomized droplets would not be “less than the wetted area on the substrate resulting from a jetting direction being perpendicular to the surface of the substrate,” as recited in claim 1. Instead, the opposite (i.e., a larger wetted area) would occur.

When a proposed modification would render a prior art invention being modified unsatisfactory for its intended purpose, or when a proposed modification or combination would change the principle of operation of the prior art invention being modified, then the teachings of the prior art references are not sufficient to render claims *prima facie* obvious. MPEP § 2143.01(V), (VI). Therefore, for at least the above reasons, Applicants submit that the Examiner has not established a *prima facie* case of obviousness with respect to claim 1. Accordingly, Applicants request that the rejection of claim 1 be withdrawn.

Rejection of claims 1-12, 14- 17, and 19-20 under 35 U.S.C. § 103(a) as unpatentable over Hynes in view of Hogan and further in view of Messerly

The Examiner rejected claims 1-12, 14-17, and 19-20 under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,447,847 to Hynes et al. (“Hynes”) in view of U.S. Patent No. 5,294,459 Hogan et al. (“Hogan”), and further in view of Messerly. The Examiner points to Hynes for the disclosure of a valve having a nozzle for directing material flow in a nonperpendicular direction to the surface of a substrate. Office Action mailed January 17, 2008, p. 4. However, the Examiner acknowledges that Hynes does not disclose the material being viscous and relies upon Hogan for this teaching. The Examiner also acknowledges that neither Hynes nor Hogan discloses droplets made by a valve seat and a valve element and relies on Messerly for the teaching of this aspect. Id. at 5. Applicants submit that the Examiner’s rejection was in error because she has 1) overlooked fundamental differences between the prior art references that make such a combination improper, and 2) is impermissibly relying upon hindsight to reject Applicants’ claims.

By way of background, the present application is directed to addressing the challenges associated with underfill operations, where dispensing accuracy and precision are critical. A typical underfill operation involves providing liquid epoxy beneath a semiconductor chip or other device attached to a printed circuit board to provide a mechanical bond that reduces stresses and strains on the existing interconnections. Because the chip is initially attached by

solder balls or pads, a gap exists between the chip and circuit board. The size of the gap is too small to directly dispense the liquid epoxy underneath the chip. However, the liquid epoxy can be drawn into the gap and underneath the chip by capillary action. Typical underfill operations thus involve depositing the liquid epoxy onto the circuit board adjacent a sidewall of the chip with a high degree of placement accuracy of the viscous material adjacent the sidewall. The horizontal distance between the jetting direction and the sidewall of the chip should be carefully measured and controlled to ensure proper capillary action.

Messerly is typical of conventional jetting dispensers used in an underfill process. As discussed above, the jetting dispenser 10' of Messerly includes a valve element 42' that impacts a valve seat 38' to eject a droplet of viscous material from a nozzle 40'. The jetting dispenser is oriented substantially perpendicular to the surface of the substrate to facilitate accurate placement of the droplets. For example, accurate measurements between the jetting direction and a sidewall of the device being underfilled can be readily obtained because the jetting direction is substantially parallel to the sidewall. These measurements are used ensure that the droplets are applied to the substrate at a location that allows for the proper amount of capillary action into the gap between the device and substrate. However, the challenges described by Applicants in paragraphs [0003] and [0004] of the application remain.

In contrast to Messerly, Hynes relates to a spray dispenser for conformal coating operations. Conformal coatings are applied onto devices and/or selected areas on a printed circuit board to provide protection from moisture and to serve as an insulator for electricity and heat. Col. 1, lines 18-22 of Hynes. The areas/spaces to which conformal coatings are applied are much greater than those associated with underfill operations. When applying conformal coating material underneath a component on the circuit board, as shown in Fig. 6 of Hynes, the momentum of the dispensed material—not capillary action—is primarily what causes the material to flow under the component. Additionally, the conformal coating material is applied to the sidewall(s) of the component in addition to the space underneath the component. Placement accuracy of the conformal coating material relative to the component is relaxed in comparison with underfill operations.

Hogan discloses a spray coating device and is merely relied upon by the Examiner for the disclosure of a viscous material. Applicants submit that the dispensing techniques in Hogan are no more relevant than those disclosed in Messerly and Hynes.

With this understanding, a person of ordinary skill in the art would not have considered combining the teachings of Messerly, Hynes, and Hogan to orient a jetting valve “to provide a jetting direction nonperpendicular to the surface of the substrate,” as recited in claim 1. The particular considerations relating to jetting dispensers and underfill operations in Messerly are not present in Hynes. A person seeking to reduce the wetted area on the substrate produced by the jetting dispenser of Messerly would not want to incorporate the conformal coating techniques of Hynes, where placement accuracy and capillary action is less of a concern.

Furthermore, “[o]ffice personnel must explain why the difference(s) between the prior art and the claimed invention would have been obvious to one of ordinary skill in the art.” MPEP § 2141. To support the rejection based on Hynes and Messerly, the Examiner merely states: “It would have been obvious to one of ordinary skill in the art at the time of the invention to have used the valve of [Messerly] to apply the droplets of applicant because [Messerly] teaches that it is a suitable apparatus for droplet application.” Office Action mailed January 17, 2008, pp. 5-6. Such a statement does not indicate any rationale supporting the obviousness determination. Applicants acknowledge that Messerly discloses droplet formation. But given the fundamental differences discussed above, a person of ordinary skill in the art would not combine the teachings of Messerly with Hynes (and Hogan) to obtain the method recited in claim 1. Applicants submit that the Examiner’s conclusory statements reflect the fact that she has overlooked fundamental differences in the prior art and is merely using impermissible hindsight to reconstruct the invention recited in claim 1. As set forth in the MPEP:

The key to supporting any rejection under 35 U.S.C. 103 is the clear articulation of the reason(s) why the claimed invention would have been obvious. The Supreme Court in *KSR* noted that the analysis supporting a rejection under 35 U.S.C. 103 should be made explicit. The Court quoting *In re Kahn*, 441 F.3d 977, 988, 78 USPQ2d 1329, 1336 (Fed. Cir. 2006), stated that “[R]jections on obviousness cannot be sustained by mere conclusory statements; instead, there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness.”

MPEP § 2141 (emphasis added).

Therefore, for at least the above reasons, Applicants submit that the Examiner has not established a *prima facie* case of obviousness with respect to claim 1. Accordingly, Applicants request that the rejection of claim 1 be withdrawn.

Claims 2-4 and 6-10 depend from claim 1, directly or indirectly and thus include at least the same recitations as claim 1. Therefore, Applicants respectfully request that the rejection of claims 2-4 and 6-10 be withdrawn for at least the above reasons as well.

Applicants further request that the rejection of claims 4 and 6-9 be withdrawn for additional reasons. Claim 4 specifies that “the substrate supports a device having a sidewall separated from the surface of the substrate by a gap,” and “iterating” several of the steps recited in claim 1 “to apply a linear pattern of viscous material on the substrate adjacent the gap.” The material only needs to be applied adjacent to the gap because capillary action is what causes the material to flow into the gap and underneath the device, as discussed above. Hynes discloses spraying material directly underneath a component on a substrate rather than applying material “adjacent” a gap formed between the component and substrate. Again, the challenges associated with underfill operations are not present in Hynes because of the relatively larger areas/spaces to which the material is applied. Therefore, Applicants request that the rejection of claim 4 be withdrawn for at least these additional reasons.

Claims 6 and 7 depend from claim 4. Claim 8 is similar to claim 4 in that it recites a device mounted on the substrate having a first sidewall and second sidewall, and “iterating” various steps recited in claim 1 “to apply a linear pattern of viscous material on the substrate adjacent the second sidewall of the device.” Claim 9 depends from claim 8. Therefore, Applicants request that the rejection of claims 6-9 be withdrawn for at least the above additional reasons as well.

The remaining claims that stand rejected (claims 11-12, 14-17, and 19-20) include recitations similar to those discussed above with respect to claim 1. Claims 14-15 also include recitations similar to claims 4 and 8. Therefore, Applicants request that the rejection of claims 11-12, 14-17, and 19-20 be withdrawn for one or more of the reasons discussed above.

With respect to rejection of claim 20, the Examiner points to Fig. 1 and col. 6, lines 8-11 of Hynes for the disclosure of directing material flow in a jetting direction nonperpendicular to the substrate without having to pivot the nozzle. Office Action mailed January 17, 2008, p. 13. However, Fig. 1 is merely a cartesian coordinate system used to help explain the invention in Hynes and the referenced passage is claim 12, which recites that “each of the plurality of coating applicators is mounted on a tiltable axis that is mounted on at least one end effector” (emphasis added). Thus, the passage referenced by the Examiner suggests that the material is applied in a

nonperpendicular direction because a component is tilted (i.e., pivoted)—the opposite of what is claimed. Therefore, Applicants request that the rejection of claim 20 be withdrawn for at least this additional reason.

New Claims

Claims 21-26 have been added to further recite aspects relating to an underfill operation. For example, claim 21 depends from claim 1 and recites a device “positioned on the surface of the substrate” and that “applying the droplet of the viscous material to the surface comprises depositing the droplet on the surface at a location spaced from a sidewall of the device.” Claim 22 then specifies that “the device is attached to the substrate by solder pads or balls that create a gap between the device and the substrate,” and that “the droplet of viscous material is deposited adjacent the gap below the sidewall of the component.” Finally, claim 23 specifies that “the device is a semiconductor chip and the substrate is a printed circuit board,” and that “the deposited viscous material moves under the semiconductor chip via capillary action.” Support for these claims can be found throughout the application, including in Fig. 3 and paragraph [0032].

Claims 24-26 recite the method of claim 14 in further detail. Claim 24 recites that “the droplet of the viscous material applied to the surface is deposited on the surface without contacting the first sidewall,” as shown in at least Fig. 3 of the application. Claims 25 and 26 are similar to claims 22 and 23, but with claim 25 depending from claim 24 instead of claim 21.

Conclusion

Applicants respectfully submit that the foregoing is a full and complete response to the Office Action mailed on January 17, 2008. If the Examiner believes any matter requires further discussion, the Examiner is respectfully invited to telephone the undersigned attorney so that the matter may be promptly resolved.

Applicants believe that no fees are due in connection with this response other than excess claims fees and the fee for a one-month extension of time. However, if such petition is due or

any fees are necessary, the Commissioner may consider this to be a request for such and charge any necessary fees to deposit account 23-3000.

Respectfully submitted,

WOOD, HERRON & EVANS, L.L.P.

/William R. Allen/

William R. Allen

Reg. No. 48,389

2700 Carew Tower
441 Vine Street
Cincinnati, OH 45202
(513) 241-2324 (voice)
(513) 421-7269 (facsimile)